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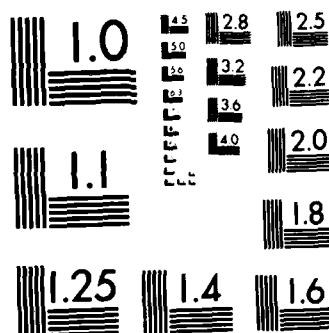
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Significant cost savings are being realized on both programs. The broadening of multiyear contracting to include requirements of all services for the same end items and for spares, support equipment, and foreign military sales offers an opportunity to achieve even more cost savings than under the current contracting approach.

The criteria for multiyear contracting, which include significant cost savings, stability of requirements and configuration, and confidence in contractor cost performance and capability, are found to be appropriate but vague. After several years of cost experience are accumulated, multiyear contract costs should be compared with those for prior annual contracts for the same systems in order to validate savings and to determine the extent to which engineering and requirements changes reduce them. At that time, the criterion for stability of requirements and configuration should be tightened.

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**COST SAVINGS FROM  
MULTIYEAR CONTRACTING**

**October 1984**

**Joseph S. Domin**

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**LOGISTICS MANAGEMENT INSTITUTE  
6400 Goldsboro Road  
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## Executive Summary

## COST SAVINGS FROM MULTIYEAR CONTRACTING

Multiyear contracting is a sensible and efficient approach to contracting for major weapon systems. We found cost savings of 8 to 9 percent in our examination of two multiyear contracts. Estimated savings are \$81 million for an Army contract with the Sikorsky Aircraft Division of United Technologies Corporation for the UH-60A BLACK HAWK helicopter; and \$258 million for an Air Force contract with the General Dynamics Corporation for the F-16 multimission fighter aircraft.

Our estimate of savings is based on comparing the proposed costs of one multiyear contract with those of several annual contracts over the same time period. The principal sources of savings in order of importance are (1) reduced prices paid by the prime contractor for parts and material, (2) avoidance of price escalation, and (3) improved efficiency of the prime contractor's operations.

Under multiyear contracting, the prime contractors procured materials in larger, more economic quantities and increased the use of competition to obtain more attractive subcontracts and purchase orders. The prime contractors avoided price escalation through earlier subcontract price commitments and by having selected items manufactured earlier. This, however, necessitated earlier expenditures, and when annual and multiyear contract costs were computed using DoD financial discounting rules, savings were reduced to 4 to 5 percent. The smallest part of cost savings was due to more efficient prime contractor operations resulting from improved material availability, a more stable work force, reduced contract administration effort, fewer production lots, and improvements in tooling and manufacturing processes.

Multiyear contracting has other benefits which tend to understate cost savings. Savings would be greater, for instance, if multiyear contract costs were compared with costs under annual contracts with year-to-year variability in quantity, or with an annual program stretched out over a longer time period. Multiyear contracting is intended to discourage both of those alternatives.

Multiyear contracting is well worth promoting. However, the criteria for multiyear contracting, which include significant cost savings, stability of requirements and configuration, and confidence in contractor cost performance and capability, are appropriate but vague. After several years of cost experience are accumulated, multiyear contract costs should be compared with those for prior annual contracts for the same systems, in order to validate savings and to determine the extent to which engineering and requirements changes reduce them. At that time, the criterion for stability of requirements and configuration should be tightened.

Finally, the broadening of multiyear contracting to include requirements of all Services for the same end items and for spares, support equipment, and foreign military sales offers an opportunity to achieve even greater savings than are now being realized.

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## 1. INTRODUCTION

The Authorization Act of Fiscal Year (FY) 1982 provides the authority to contract for up to 5 years of requirements for major weapon systems provided certain criteria are met. Funding continues to be approved in Congress on an annual basis, just as it is under annual contracting, and contractors are entitled to recover both recurring and nonrecurring costs for work performed on future years' requirements in the event of contract termination during a fiscal year and/or cancellation of future program requirements.

The Department of Defense (DoD) policy encourages the use of multiyear contracting for major weapon system programs when the risks will be offset by cost avoidance or other benefits. The risks are associated with criteria specified in the 1982 DoD Authorization Act: significant cost savings, stability of requirements and configuration, and confidence in contractor cost performance and capability.

Multiyear contracting has been a major initiative in DoD for nearly 3 years. To ensure its best possible application, the Office of the Deputy Under Secretary of Defense for Research and Engineering (Acquisition Management) asked the Logistics Management Institute (LMI) to evaluate the recent experience in multiyear contracting and to recommend appropriate improvements to increase benefits and reduce risks.

Specifically, we have assessed actual experience under two representative multiyear contracts (MYCs) -- one, an Army contract with Sikorsky Aircraft for the UH-60A BLACK HAWK helicopter and the other, an Air Force contract with the General Dynamics Corporation for the F-16 multimission fighter aircraft. Our assessment focuses on determining whether the criteria for deciding on the use

of multiyear contracting are adequate, assessing the effects of MYCs on contractors' operations and contractors' relationships with subcontractors and vendors, and determining the extent to which projected savings can be validated. Finally, some improvements in multiyear contracting are recommended.

## 2. FINDINGS

### COST SAVINGS

Cost savings attributable to the first MYCs for the UH-60A BLACK HAWK helicopter and F-16 multimission fighter aircraft are shown in Table 2-1. Estimated savings on the purchase of 294 UH-60A airframes are \$81.1 million, or 7.9 percent of the cost of procuring the same 294 airframes using three annual contracts. Estimated savings on the purchase of 480 F-16 airframes are \$258.0 million, or 8.9 percent of the cost of using four separate annual contracts.

TABLE 2-1. MYC COST SAVINGS

	UH-60A BLACK HAWK	F-16 MULTIMISSIION FIGHTER
Aircraft Quantity	294	480
Fiscal Years	1982-1985	1982-1986
Estimated Cost Under Annual Contracting	\$1,031.1M <sup>a</sup>	\$2,902.8M
Negotiated MYC Costs	\$ 950.0M	\$2,644.8M
Estimated Cost Savings	\$ 81.1M <sup>a</sup>	\$ 258.0M <sup>b</sup>
Estimated Savings		
As Percent of Annual Contract Costs	7.9%	8.9%
As Percent of Discounted Annual Contract Costs	4.8%	4.3%

<sup>a</sup>Sikorsky's estimate.

<sup>b</sup>F-16 Program Manager's estimate, which differs from that of General Dynamics' only in the Program Manager's use of lower inflation rates to forecast the cost of future annual contracts.

Some of the savings attributed to MYCs result from earlier expenditures of effort and money than is permitted under annual contracting. When

estimated savings streams are discounted in accordance with DoD policy,<sup>1</sup> savings on the UH-60A and F-16 MYCs become 4.8 and 4.3 percent, respectively.

Both the UH-60A and F-16 programs are candidates for follow-on MYCs. Army budget estimates indicate that an additional 2 percent savings (i.e., 10 percent total) might be realized on the UH-60 program as a result of the follow-on MYC. Estimated percentage savings on the second MYC for the F-16 are close to savings attributed to the first MYC.

#### BASIS FOR SAVINGS ESTIMATES

The estimated savings are based on the prime contractor proposals. Both contractors submitted proposals for an annual contract and an MYC and were prepared to accept the award of either type of contract. Sikorsky submitted a firm fixed-price (FFP) proposal, whereas General Dynamics submitted a fixed-price-incentive (FPI)-type proposal. Proposals from both contractors were based on FFP proposals from their subcontractors and vendors who submitted price quotations for annual and multiyear quantities. The F-16 subcontractors were asked to submit FFP proposals for a broad range of delivery quantities at several alternative production rates that covered all possible annual and multiyear quantities extending through the quantities planned for the second MYC.

To calculate annual contract costs for the same period as the MYC, both contractors applied inflation rates to the proposed costs for a single annual contract. Proposed MYC costs were subtracted from comparable inflated annual contract costs to obtain the estimate of savings attributed to multiyear contracting. In the case of the F-16, the contractor's original estimate of savings of \$350.0 million was reduced to \$258.0 million where the F-16 program

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<sup>1</sup>"Economic Analysis and Program Evaluation for Resource Management," DoD Instruction 7041.3, October 18, 1972.

manager applied the lower official inflation rates published by the Office of Management and Budget to annual contract costs.

Only the MYCs were negotiated by the Services. However, the Services and the contractors felt that the reduction in contract costs obtained through negotiations would have been the same for the annual contracts as for the MYC and the estimate of savings would, therefore, not be affected.

#### SOURCES OF SAVINGS

Savings attributable to multiyear contracting have been realized in the areas of vendor procurement, prime contractor in-house effort for manufacturing and design/engineering, and inflation avoidance.

Savings in vendor procurement result from the prime contractor being able to purchase in larger, more economical lot sizes, sometimes referred to as economic order quantities (EOQ). These larger quantities have also enabled prime contractors to increase their use of competition or the threat of competition to obtain lower prices from vendors. In addition, Sikorsky developed competitive alternate sources for selected items and plans a further increase in the use of competition in its second MYC.

The combination of EOQ orders and competition that results in lower vendor procurement costs accounts for 75 to 90 percent of cost savings attributable to MYC, excluding savings from inflation avoidance. Both Sikorsky and General Dynamics reported that vendor procurement costs (including prime contractor materials overhead) constitutes about two-thirds of total airframe contract costs.

The remaining 10 to 25 percent of savings results from improved production efficiency in the prime contractors' operations. Sikorsky reported increased material availability, a more stable work force, and improved production planning that resulted in fewer disruptions to production processes.

General Dynamics reported reduced fabrication manhours achieved by producing selected parts in multiyear quantities, reduced set-up time resulting from a reduction in the number of production lots from four to three, increased buffer stocks, and improvements in tooling and machine operations.

Inflation avoidance is the third source of savings attributable to MYC. Inflation can be avoided under multiyear contracting because vendor price commitments are obtained earlier for a 3- or 4-year period and because materials are procured and some actual production is completed earlier. Estimates of inflation avoidance savings on the UH-60A and F-16 programs are 60 and 24 percent, respectively, of total estimated savings (undiscounted).

On the negative side, earlier expenditures of funds are required under the MYC. Total estimated savings in the 8 to 9 percent range are reduced to 4 to 5 percent when cost savings are discounted. The discounting calculation effectively attaches a cost to the earlier expenditure profile of MYCs which tends to offset the amount of inflation avoidance.

#### VALIDATION OF SAVINGS ESTIMATES

Savings estimates are based on firm contractor price proposals for annual and multiyear contracts, which are in turn based on vendor/subcontractor price quotations. These savings estimates cannot be directly validated because both contracts could only be executed one way and, as with all airframe contracts, many contract changes were made. Prime contractor accounting systems do not separate costs on the original MYC from costs of change orders.

An indirect means of validating savings estimates is to compare the unit labor and materials cost of airframes procured under multiyear contracting to the unit costs experienced under previous annual contracts for the same work. Prior to Sikorsky's first MYC, 337 UH-60A airframes were produced under five annual contracts. Prior to General Dynamic's first MYC, about

1,000 F-16s were produced under annual contracts. Work on the MYCs is in progress and actual production cost by lot under the MYC is not yet available. When these data become available, the comparison of MYC and prior annual contract unit labor and material costs (in constant dollars) should reveal a reduction in airframe unit cost attributable to the MYC.

This procedure for validating savings estimates is indirect since airframes are constantly subject to engineering changes and the airframes in the MYC are not necessarily identical to those in the prior annual contract. In addition, other factors such as the influence of competition on prices paid for the first few lots may affect the comparison. Nevertheless, multiyear contracting should be exerting a definite cost-reducing force that is noticeable when a comparison of this type is made on a group of major weapons programs that have accumulated experience under MYCs.

#### SUBCONTRACTING

The single largest change under multiyear contracting is in the area of subcontracting for parts and materials. Subcontracts are written for larger quantities, which allow the vendors to produce items more efficiently through earlier materials procurement, cost-reducing investments in plant and equipment that can be amortized over several years of production, and more efficient planning and work scheduling. The larger subcontracts draw the interest of more companies, thereby stimulating competition.

Both Sikorsky and General Dynamics made fundamental changes to their approaches to subcontractors to take advantage of the new multiyear contracting authority.

Sikorsky's approach to subcontracting under multiyear contracting featured a direct management approach combined with an enhanced use of competition. Sikorsky sent management teams to subcontractor plants to review and

advise on their production process and to provide cost guidelines and target unit costs. Sikorsky increased the level of competition for subcontracts by 77 percent compared with that of the prior annual contracts in terms of the dollar value competed. Furthermore, 11 new suppliers were qualified as second sources and awarded subcontracts to increase the level of competition. Further increase in the dollar value competed and the number of second sources is planned for the second (follow-on) MYC.

General Dynamics obtained price quotations from its subcontractors for a broad range of quantities and production rates covering quantity requirements through 1988. These "priced options" allowed General Dynamics to buy one or more years of required quantities from the proposed schedule of prices that decreased with increasing procurement quantities. Eight of 32 major subcontracts were competed, and, of these, two sources were changed. An additional 11 subcontractors proposed lower prices after competition was threatened. On selected high-volume, low-cost items, proposed priced options were obtained for up-front delivery and for deliveries spread over time. Cost savings associated with this option were balanced against storage costs to determine the desirability of this approach.

#### CAPITAL INVESTMENTS

Sikorsky identified \$16.2 million of investments in plant and equipment that were stimulated by the MYC. The investments could now be amortized over a 3-year period. Furthermore, since the prime contract is FFP, any cost reductions resulting from these investments become profit to Sikorsky for the duration of the MYC. Sikorsky also provided lists of investments made by its subcontractors that were directly or indirectly stimulated by the FFP multi-year subcontracts. An FFP MYC provides strong incentives for making cost-reducing investments in plant and equipment.



General Dynamics has invested in plant and equipment as a result of the Air Force's technology modernization program. These investments would have been made whether the F-16 contract was awarded on an annual or multiyear basis. The longer-term stability associated with the MYC, however, is credited with providing a firm basis for planning capital improvements in the context of the technology modernization program. General Dynamics awards FFP multiyear subcontracts to its suppliers, but information on the extent to which that procedure has stimulated investments in plant and equipment at the subcontractor level was not available at General Dynamics and visits to subcontractors were beyond the scope of this study.

#### CRITERIA FOR MULTIYEAR CONTRACTING

The criteria for multiyear contracting are significant cost savings, stability of requirements and configuration, and confidence in contractor cost performance and capability. If, during the term of an MYC, change orders alter the procurement quantity or the configuration, it is likely that some erosion of estimated savings will result. These changes disrupt an otherwise smooth production process and result in increased costs. In budget justification data for the second MYC on the F-16, the estimated savings are \$358.3 million, or 8.4 percent of annual contract value if 720 airframes are produced over 4 years. If options are exercised on an annual basis to procure 36 additional airframes per year, then estimated savings on 864 airframes decline to \$227.1 million, or 4.6 percent of equivalent annual contract value.

A certain amount of engineering change is expected in any production program. The F-16 and UH-60A have undergone engineering changes during the course of the MYC, and 54 airframes were added to the original requirement of 480 F-16 airframes. The exact effect of these changes on projected savings attributable to multiyear contracting is not yet known. When several years of

actual cost experience data by production lot have been accumulated on a number of MYCs, these costs can be compared with costs for prior annual contracts for the same end item to determine whether:

- Costs of engineering changes on MYCs tend to be greater than those on prior annual contracts
- Total cost per unit is less on the MYC than on prior annual contracts
- MYC programs with more engineering and quantity changes show less cost reduction when compared to costs under prior annual contracts.

Based on this type of analysis, a more refined definition of the criterion for stability of requirements and configuration should be possible.

#### PERFORMANCE REVIEW DATA

The following type of data is needed for an Office of the Secretary of Defense (OSD) level of review of performance under multiyear contracting:

- Comparative cost experience data of the type available on some programs in the Cost Information Reports/Contract Cost Data Reports available from OSD, Program Analysis and Evaluation. These data include manufacturing cost by production lot for parts and materials; and production, engineering, and tooling hours and costs. The data should be reviewed for all production lots including those produced on the early annual contracts to determine whether unit production costs under multiyear contracting are less than those under annual contracts, particularly in the parts and materials cost area in which the multiyear effect should be most noticeable.
- Costs for engineering and quantity changes for annual and multiyear contracts are needed to determine the extent to which the changes affect the savings realized from multiyear contracting.
- Dollar value and percent of total dollar value of subcontracts that were competed for annual and MYCs.
- Amounts spent on cost-reducing investments in plant and equipment as a result of the MYC.

### 3. CONCLUSIONS AND RECOMMENDATIONS

Based on our review of the UH-60A and F-16 MYCs, we conclude that multi-year contracting is a sensible and efficient approach to contracting for major weapons systems that saves about 8 or 9 percent of total costs when compared with annual contracting over the same period. Our estimate is based on comparing contractor-proposed costs on one MYC with those of several annual contracts over the same time period. The savings estimates should be validated when several years of actual manufacturing cost under MYCs have been accumulated.

Part of the original motivation for multiyear contracting was to forestall problems associated with year-to-year variations in the procurement quantity and program stretchouts that result in procuring needed quantities over a longer time but at a greater unit cost. If 3- or 4-year MYC costs were compared with annual contract costs over a longer period, savings would be greater than the 8 to 9 percent currently estimated.

We also conclude that a significant change in the prime contractor's approach to subcontracting is required to maximize the cost-reduction potential of multiyear contracting. Specifically, the prime contractors have encouraged and utilized competition when buying the larger quantities of parts and materials. Sikorsky uses a more direct approach to advising and negotiating with its subcontractors.

Savings from multiyear contracting, however, can be eroded by requirements and engineering changes, and in extreme cases, MYC costs can be higher than annual contract costs. This would occur if parts that are produced earlier under an MYC become subject to engineering changes that result in

their being scrapped or reworked. In addition, any increases in the procurement quantity must be obtained at annual subcontract price levels while the production process is modified to accommodate the higher production rate. Decreases in quantity mean reducing production rate and, perhaps, underutilizing plant and equipment capacities. Such changes will result in some erosion of savings attributed to multiyear contracting.

As a result of our review of multiyear contracting for the UH-60A BLACK HAWK helicopter and the F-16 multimission fighter, we recommend that DoD:

- Review performance under MYCs when a significant amount of data on actual manufacturing cost by production lot has been accumulated. This review should focus on the comparison of cost experienced on MYCs to costs experienced on prior annual contracts to determine the extent to which cost reductions have been achieved by the MYC and to evaluate the effects of engineering and quantity changes on savings projections.
- Develop and implement an approach to combining requirements of the Services and foreign customers for the same end items, including any spares and support equipment, into one MYC. This procedure will allow the prime contractor to achieve multiyear savings over a broader contractual base by purchasing parts and materials in larger quantities and by increasing stability and improving planning and efficiency of internal production operations.
- Refine the definition of requirements and configuration stability. One or both of these factors are present to some extent in every production program. Based on a review of actual performance under MYCs, a more specific definition of these criteria for multiyear contracting should be possible.

## APPENDIX A

### CASE STUDY -- UH-60A BLACK HAWK HELICOPTER

#### BACKGROUND

##### Program Description

The BLACK HAWK<sup>1</sup> is a twin-engine helicopter employed in air assault, air cavalry, and aeromedical evacuation missions. This aircraft is the Army's first true squad assault helicopter. It performs the missions of transporting troops and equipment into combat, resupplying the troops while in combat and performing the associated functions of aeromedical evaluation, repositioning of reserves, and conducting command and control. The UH-60A BLACK HAWK is replacing the UH-1H IROQUOIS in air assault, air cavalry, and aeromedical evacuation units.

Programs related to the BLACK HAWK include the Army's electronics helicopter, EH-60A QUICK FIX, and attack helicopter AH-64 APACHE; the Navy's SH-60B SEAHAWK, Global Positioning System (GPS); the Air Force's HH-60D NIGHT HAWK; and the Army's UH-60A BLACK HAWK Flight Simulator. The airframe prime contractor is the Sikorsky Aircraft Division of United Technologies Corporation located in Stratford, Connecticut. The engine prime contractor is General Electric (GE) Corporation located in Lynn, Massachusetts.

##### Program History

On June 11, 1971, the BLACK HAWK program was approved by the Deputy Secretary of Defense for full-scale development, and on March 6, 1972, a contract was awarded to GE to develop a 1500-shaft horsepower advanced technology

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<sup>1</sup>Source of program information is the Selected Acquisition Report, December 31, 1983.

engine. On August 30, 1972, contracts were awarded to Boeing Vertol and Sikorsky Aircraft to develop the BLACK HAWK airframe. Prototype qualification testing commenced on October 17, 1974, and was completed on December 8, 1976. These tests accumulated 2990 flight test hours and 2676 ground vehicle test hours. The BLACK HAWK was approved for production as a result of Defense Systems Acquisition Review Council (DSARC) III, held on November 30, 1976. On December 23, 1976, Sikorsky Aircraft was awarded a Fixed Price Incentive (FPI) contract with three options for fiscal year (FY) 1977-1980 BLACK HAWK production. On May 5, 1981, the Army definitized the award of an FY 1981 FPI airframe contract to Sikorsky Aircraft, and on April 12, 1982, the Army awarded an FY 1982-1984 airframe multiyear firm-fixed-price (FFP) contract for 294 UH-60A BLACK HAWK and derivative airframes to Sikorsky Aircraft. The Army awarded GE six contracts for procurement of T-700-GE-700 engines for the BLACK HAWK.

The subject of this case study report is the multiyear FFP contract for 294 UH-60A BLACK HAWK and derivative airframes awarded to Sikorsky Aircraft on April 12, 1982.

#### General Approach

Multiyear contracting for the UH-60A BLACK HAWK helicopter program was selected for detailed evaluation because it was among the first multiyear contracts (MYCs) approved by the Department of Defense (DoD). Information on this program was obtained from Selected Acquisition Reports and Contractor Cost Performance Reports and from staffs in the Office of the Secretary of Defense and Army Headquarters. Interviews were conducted during visits with staffs from the following organizations:

- BLACK HAWK Program Managers' Offices  
St. Louis, Missouri

- BLACK HAWK "Should Cost" Team  
St. Louis, Missouri
- Sikorsky Aircraft Division of United Technologies Corporation  
Stratford, Connecticut.

# MULTIYEAR CONTRACT

## Description

The first MYC, MYC1, for the UH-60A was awarded on April 12, 1982, for 294 airframes for a negotiated firm fixed price of \$950.0 million. The contract had economic price adjustment and business base adjustment clauses. As of April 1984, 171 of the 294 aircraft had been delivered, and the remainder are to be delivered by March 1985.

Table A-1 shows the negotiated contract cost values by contract line item number (CLIN). CLIN 0001, 0010, and 0020 are for 102, 96, and 96 UH-60A airframes corresponding to production lots 6, 7, and 8, respectively, which include the Army's requirements for FY 1982 through FY 1984.

TABLE A-1. DOLLARS BY CONTRACT LINE ITEM  
FOR THE BLACK HAWK MYC1

CLIN	NOMENCLATURE	QUANTITY	UNIT PRICE	TOTAL PRICE
0001	Helicopter, UH-60A	102 Each	\$2,972,000	\$303,144,000
0002	Data	--	--	NSP <sup>a</sup>
0003	Systems/Project Management	--	--	4,279,000
0004	Peculiar Support Equipment	--	--	1,650,000
0010	Helicopter, UH-60A	96 Each	3,198,000	307,008,000
0011	Data	--	--	NSP
0012	Systems/Project Management	--	--	4,992,000
0014	Training	--	--	927,000
0020	Helicopter, UH-60A	96 Each	3,357,000	322,272,000
0021	Data	--	--	NSP
0022	Systems/Project Management	--	--	5,728,000
TOTAL				\$950,000,000

<sup>a</sup>Not separately priced.

### Justification of MYC1

The original justification included estimated savings of \$75.4 million based on acquisition of 276 airframes for \$1,006.6 million if three annual contracts were awarded and \$931.2 million if one MYC was awarded. The MYC was later definitized at \$950.0 million for 294 airframes with estimated savings of \$81.1 million. The risks associated with potential instabilities in Army requirements, availability of funds, configuration stability, estimated costs, and contractor capabilities were all judged to be low.

Favorable impacts on the defense industrial base were foreseen to result from efficiencies stimulated by increased competition for larger subcontracts and enhanced investment in plant and equipment at both the prime contractor and subcontractor levels.

### Estimates of Savings

In October 1981 in response to an Army request, Sikorsky submitted a proposal for an annual contract to provide 108 BLACK HAWK helicopters, the FY 1982 requirement, and an MYC for 300 helicopters, the total of FY 1982, FY 1983, and FY 1984 requirements. Sikorsky also submitted its estimate of \$81.1 million savings resulting from use of one MYC rather than three annual contracts.

The genesis of the proposed and negotiated annual and MYC values and savings estimate is summarized in Table A-2. To obtain the proposed value of \$1,217.6 million for three annual contracts, the Sikorsky proposal for a single year was used and two additional annual contracts were projected by applying inflation rates of 12 percent for certain materials and 10 percent for labor to values in the FY 1982 annual contract. The proposed MYC value of \$1,136.5 million was independently derived using subcontractor proposed costs combined with Sikorsky's estimate for in-house effort. Sikorsky included in



its multiyear proposal an estimated 5-percent reduction in subcontractor proposed costs for major items. Sikorsky believes this is a conservative estimate of the additional amount that can be negotiated from supplier-quoted prices if multiyear rather than annual contracting is used.

TABLE A-2. UH-60A MULTIYEAR CONTRACT AND "SHOULD COST" SAVINGS

	CONTRACT PRICE
Single Year Proposal + 2 Years Projected (300 Airframes)	\$1217.6M
Multiyear Savings	<u>81.1M</u>
Multiyear Proposal (300 Airframes)	1136.5M
Less Six Aircraft	<u>20.9M</u>
Subtotal	1115.6M
"Should Cost" Savings	<u>165.6M</u>
Negotiated Settlement	<u>\$ 950.0M</u>

The difference between proposed annual and MYC costs is \$81.1 million, the estimate of savings attributed to MYC. Reductions of \$20.9 million for six fewer helicopters and \$165.6 million obtained through the negotiations process apply equally to MYC and annual contracts and result in the final contract value of \$950.0 million.

The estimate of savings attributable to the MYC is based on contractor-proposed costs and estimates for two additional years in the case of annual contracting. Sikorsky also applied its estimate of 5-percent reduction in multiyear subcontractor-proposed prices attributable to a projected improved negotiations outcome under MYC. The MYC was awarded on April 12, 1982. Since this contract was and could only be executed one way, there is no direct means of validating the estimates and assumptions on which the projections of savings were based.

### Cost to Complete MYC1

Changes to MYC1 and the estimated cost to complete the contract are presented in Table A-3. Cost decreases resulted from increasing the production rate from 8 to 10 airframes per month. Inflation was less than estimated in the MYC, and the economic price adjustment clause resulted in a reduction in the FFP contract value of \$30.0 million.

TABLE A-3. ESTIMATED COST TO COMPLETE MYC1  
AS OF MAY 1984 (\$ MILLIONS)

Contract Award Value (April 12, 1982)	\$950.0
Decreases:	
Accelerated Delivery	(27.4)
Economic Price Adjustment	(30.0)
Increases:	
Business Base Adjustment	9.0
External Stores Support System (ESSS)	13.1
Anti-Ice, De-Ice	10.4
Mission Flexibility Kits	16.6
Other Engineering Change Proposals (ECPs)	10.0
Undefinitized ECPs, Field Service Representatives and Training	8.4
Cost to Complete MYC1	\$960.1

The higher production rate of ten airframes per month is economically efficient and results in lower costs for acquisition of BLACK HAWK airframes. However, the Army is planning to return to a reduced production and delivery rate of eight per month because the funding requirements and expenditure rates implied by the higher production rate has adverse impacts on other Army programs.

Cost increases result from the Sikorsky business base being less than estimated in the MYC, the addition of mission kits, the ESSS system, ECPs, and other items. The total of all contract changes results in the final estimate to complete of \$960.1 million.

One of the requirements for approval of MYCs is configuration stability. Potentially, costs of configuration changes can be higher under multiyear than annual contracting since some parts are subject to earlier production and subcontracts can "lock you in" for several years. However, available guidance provides no specific definition of what constitutes configuration stability. In the case of the BLACK HAWK, about \$30 million (or 3 percent of total cost) in contract changes results from changes to the configuration. This amount does not appear to be excessive. Sikorsky schedules and otherwise manages the implementation of change orders to minimize adverse cost impacts.

#### MYC2

The Army has submitted budget justification for a second MYC for 234 UH-60A and 54 EH-60A airframes for \$1,259.0 million under annual contracting or \$1,132.7 million under multiyear contracting, a savings attributable to the MYC of \$126.3 million or 10 percent (about 8 percent if discounted costs are used). Sources of savings are inflation avoidance (28 percent), vendor procurement (65 percent), and manufacturing efficiencies (7 percent). As in MYC1, all risk factors associated with the BLACK HAWK program were judged to be low.

The 10-percent estimate of savings attributable to MYC2 is somewhat higher than the 8-percent claimed for MYC1. According to Sikorsky, results obtained on MYC1 from subcontract negotiations and increased competition for subcontracts were better than anticipated. A further increase in vendor competition including increased use of alternate (dual) competitive sources is planned for MYC2 and should result in lower costs.

## EFFECT ON PRIME CONTRACTOR OPERATIONS

### Investment in Plant and Equipment

Multiyear contracting should have a stimulating effect on cost-reducing investments in plant and equipment. The contractor is assured that a longer period of time and greater volume of business is available for recovering investment and earning a profit. Furthermore, the MYC eases the problems of corporate approval and borrowing, if needed, from financial institutions.

MYCs can be of several types: FFP, FPI, etc. The contract type affects profitability and, therefore, the incentive associated with a capital investment. The BLACK HAWK MYC is an FFP contract covering 3 years' requirements. Cost reductions achieved through capital investment are translated totally into corporate profits for the life of the contract. The Government then has the opportunity to negotiate a follow-on contract based on the lower cost of production experienced on MYC1.

Table A-4 displays the Sikorsky Aircraft Division capital investments attributed to the BLACK HAWK MYC1. Internal rate of return (IRR) for each investment is shown for the entire buy and with the contract quantity reduced by 50 percent. Clearly, the profitability and the incentive to invest are reduced when the procurement quantity is reduced.

TABLE A-4. CAPITAL INVESTMENT ATTRIBUTED TO BLACK HAWK MYC1

CAPITAL INVESTMENT	APPROPRIATED AMOUNT (1983 \$)	IRR	IRR WITH BLACK HAWK QUANTITY REDUCED 50%
Flange Cell	590,450	42%	20%
ESSS Cell	1,000,000	30%	15%
ASRS (Shelton II)	356,000	30%	14%
Trumpf Drill & Route Center	743,000	38%	20%
Paint Finishes	13,435,000		
Spindle/Cuff Cell	2,000,000	56%	28%
TOTAL	18,124,450		

Source: Sikorsky Aircraft Division of United Technologies Corporation.

### Production Process Efficiency

The MYC allows for advanced procurement of long-lead-time materials and parts needed for airframes to be produced in subsequent years. According to Sikorsky, this ability has improved deliveries of spare parts orders to the extent of eliminating delinquencies in 1983 and also has shortened the lead time on parts orders from 18 to 24 months in 1981 to 7 to 12 months in 1983.

Multiyear contracting has resulted in increased availability of production materials thereby reducing the delay in production caused by material shortages. The MYC, according to Sikorsky, also contributes to a sense of job security, improved worker morale, and a more stable work force.

### Reduced Administrative Effort

Less time and expense are required for a contract bid and proposal effort, contract negotiation, and contract administration for one MYC than for multiple annual contracts. Both the Army and Sikorsky apparently put more effort into the 3-year MYC development and negotiation process than they would have for any single annual contract but less than for three annual contracts. The Army had sizable "should-cost" teams assigned to the negotiation of both MYC1 and MYC2. Those teams are not used to negotiate all annual contracts.

At the subcontract level, too, Sikorsky spent less time for cost and price analysis and for negotiations of subcontracts or purchase orders for this one MYC than it would have for three annual contracts. Sikorsky reports that the up-front effort in the bid, proposal, and negotiations process for this one MYC is greater than for one but less than for three annual contracts. Fewer purchase orders are required with one MYC since in many cases each purchase order replaces three that are needed with annual contracts.

### Assessment

Cost savings at the prime contractor level that are attributable to investments in plant and equipment, production process efficiencies, and reduced administrative expenses are a minor part of savings attributable to multiyear contracting. In both MYC1 and MYC2, these sources account for less than 10 percent of total savings. Savings in vendor procurement costs and inflation avoidance make up 90 percent or more of all savings attributable to multiyear contracting.

### RELATIONSHIPS WITH SUBCONTRACTORS AND VENDORS

#### Competition

The attractiveness of multiyear contracting has stimulated an increased level of competition among current and potential suppliers of parts and materials for the BLACK HAWK airframe. Figure A-1, reproduced from charts provided by Sikorsky, shows the comparison in the level of competition experienced under prior annual contracts with that experienced in MYC1 and projected for MYC2. There was an 87-percent increase in the dollar value of materials competed in MYC1 when compared to experience in the annual contract for Lot 5. An additional increase to 277 percent of Lot 5 values is projected for MYC2.

The cost per airframe in MYC1 is about \$3.1 million; 65-percent, or \$2.0 million, is for materials purchases including Sikorsky costs for materials overhead and allocated profit (about \$1.1 million is direct cost of materials without Sikorsky charges included). Of this \$2.0 million, 41-percent, or \$0.8 million, was competed in MYC1 and 61 percent, or \$1.2 million, is projected for competition in MYC2.

Of the total materials competed, 11 items were subjected to alternate or second-source contracting procedures. Table A-5 shows the cost per airframe for major items as experienced in Lots 4 and 5 under annual contracts

FIGURE A-1. MULTIYEAR CONTRACTING ENHANCES COMPETITION

BLACK HAWK EXPERIENCE

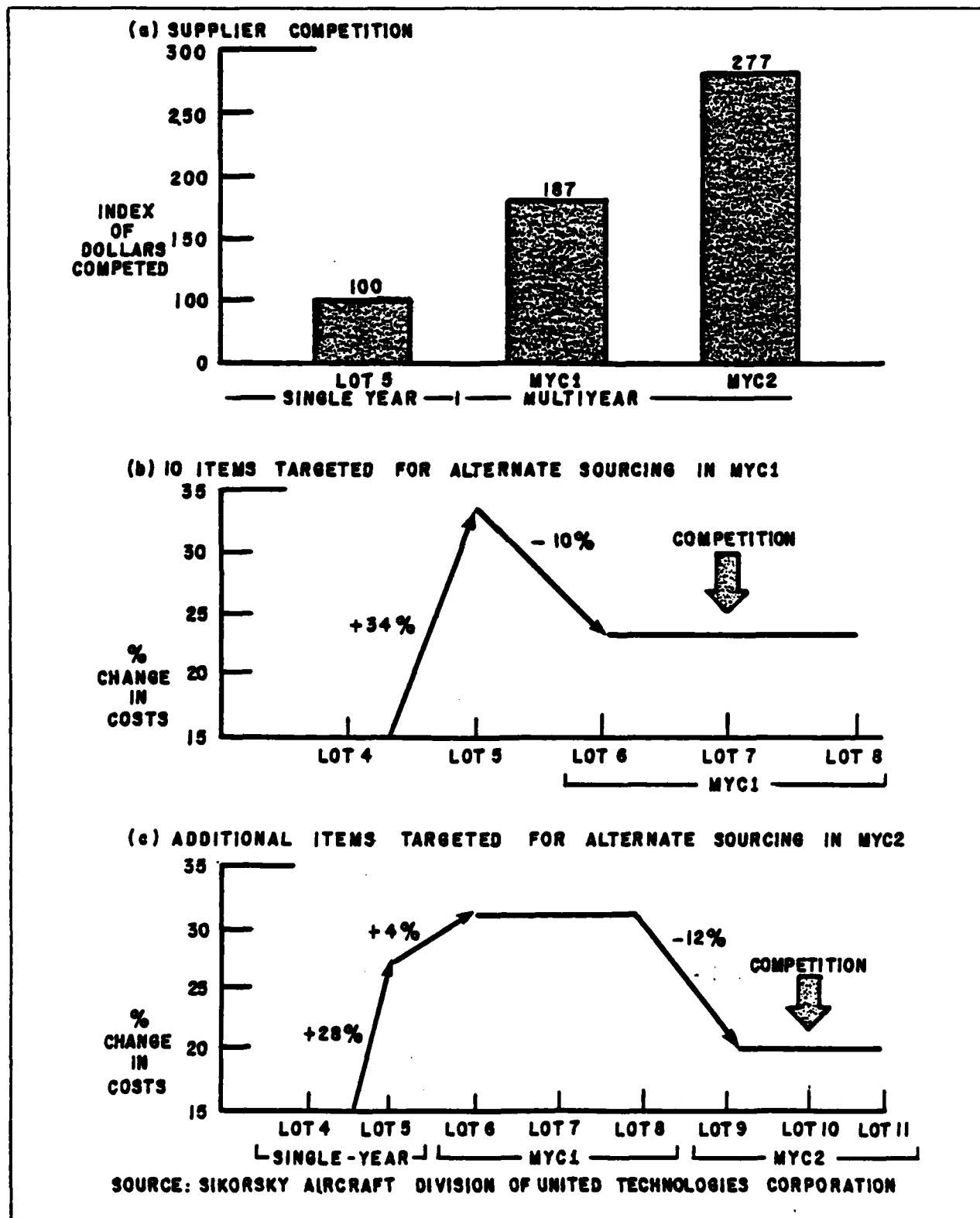


TABLE A-5. COSTS FOR MAJOR ITEMS FROM EXISTING  
AND ALTERNATE SOURCES

ITEM	LOT 4	LOT 5	MYC1	
			EXISTING SOURCE	ALTERNATE SOURCE
A	\$ 2,400	\$ 2,000	\$ 1,700	\$ 1,600
B	13,000	19,000	19,500	17,000
C	3,700	4,300	5,600	4,000
D	1,400	1,400	1,000	600
E	7,700	9,500	8,500	6,800
F	25,800	40,600	31,900	27,400
G	2,600	2,600	2,300	2,000
H	2,200	2,800	2,600	2,100
I	1,800	2,000	2,700	4,100
J	10,200	10,200	11,600	8,700
TOTAL	\$70,800	\$94,400	\$87,500	\$74,300
PERCENT CHANGE OVER PRIOR LOT		33.3%	(7.3%)	(21.3%)

Source: Sikorsky Aircraft Division of United Technologies Corporation.

with prices charged by the existing and alternate sources in MYC1. Alternate sourcing resulted in cost reductions of from 7.3 percent to 21.3 percent depending on the distribution of purchase order quantities between the existing and alternate source. According to Sikorsky, the entire award could not always be made to the low bidder because of the time required to qualify certain items and the confidence level in the ability of the alternate source to meet quality and delivery requirements. Sikorsky indicates that a conservative estimate of savings based on the above data is 10 percent.

#### Intense Negotiations

Included in the \$81.1 million estimate of savings attributed to MYC1 is Sikorsky's estimate that 5 percent more would be negotiated off supplier-proposed prices for an MYC than for annual contracts. The increased desirability of multiyear contracting and real competition or the threat of



competition are factors contributing to the enhanced bargaining power of the prime contractor when negotiating a subcontract under an MYC.

Sikorsky management reported that the initial supplier bid, proposal, and negotiation process is more extensive under an MYC, but the process is done once rather than multiple times as is the case with annual contracts. Sikorsky has sent management teams to high-value suppliers to provide information on the scope, purpose, and intent of the multiyear subcontract. Sikorsky also provides target or ceiling pricing guidance (should cost) and suggestions on how to improve the prospective supplier's production process based on the review and recommendations of Sikorsky production specialists.

#### EFFECTS ON SUBCONTRACTOR OPERATIONS

##### Investment in Plant and Equipment

According to Sikorsky, the MYC has stimulated investments in plant and equipment at the manufacturing facilities of its first tier of subcontractors/suppliers. Table A-6 lists industrial base production facility improvements based primarily on the multiyear award, and Table A-7 lists improvements wherein the multiyear award was a contributing factor. It is also possible that multiyear contracting has stimulated investments in plant and equipment at manufacturing facilities of second-tier suppliers (i.e., suppliers of parts and materials to Sikorsky's subcontractors). However, investigation of these potential effects was beyond the scope of this case study.

##### Other Effects

The prices proposed by Sikorsky suppliers were significantly lower for the MYC than for the annual contracting. This reduction has been attributed both to inflation avoidance because of the earlier contract commitment; the larger, more-economic lot sizes; and increased competition.

**TABLE A-6. IMPROVEMENTS IN PRODUCTION FACILITIES**  
**ON BASIS OF AWARD OF MYC**

SUPPLIER	IMPROVEMENTS
Rosemount Minnesota	Provided new aerospace division headquarters and facilities expansion for the manufacture of pitot static tubes and air data and air speed transducers. Also, included a number of burn-in and test station locations specifically for production of BLACK HAWK components.
Teledyne Controls California	Expanded manufacturing burn-in facilities to enable increased production in support of BLACK HAWK caution and warning panel hardware.
Macor New York	Purchased new Cadillac lathes and several new Mazac machining centers, specifically for the manufacture of BLACK HAWK machine parts.
Windsor Manufacturing Co. Connecticut	Added an additional 60,000 sq ft to its present facility and purchased new machining centers specifically for the fabrication of pressure plates and other machined parts for Sikorsky.
Chicago Rawhide Illinois	Elected to invest a substantial amount of time, effort, and money in a program to redesign and requalify the BLACK HAWK Elastomeric Main Rotor Bearings in an effort to become a viable alternate source to Lord Kinematics. This decision was made based upon the long-range potential of the BLACK HAWK program and was further supported by Sikorsky's willingness to release multiyear procurements.
Curtiss Wright (CW) New Jersey	In June 1981, began a facilities expansion program to meet BLACK HAWK production requirements. Original 800 sq ft was expanded to 2,040 sq ft in August 1981 and to a current 3,048 sq ft. Fifteen people have been added to CW BLACK HAWK effort. In addition, CW has provided at its facility, a separate finish stores area for BLACK HAWK inventory.
Aircraft Hydroforming California	Installed a new press for the manufacture of sheet metal formed parts, specifically titanium components for BLACK HAWK main rotor blades.
Moog, Inc. New York	Added a second test rig to increase test capability to 60 units per month including BLACK HAWK and SEAHAWK Pitch Trim Servos and SEAHAWK Roll Trim Servos. The additional test rig also alleviates competition for the test time between production hardware and Army repairs.
Clark & Wheeler California	Procured a lathe grinder for the external splines on the BLACK HAWK Main Shaft which will increase their efficiency and production output.
Monogram Peacock California	Procured, and has in operation, two additional lathes for the BLACK HAWK landing gear.
Data Products	Installed automated testing equipment that decreases the amount of testing time required for logic modules resulting in increased productivity and better capacity to meet Army spares requirements.

Source: Sikorsky Aircraft Division of United Technologies Corporation.

**TABLE A-7. IMPROVEMENTS IN PRODUCTION FACILITIES WHERE  
AWARD OF MYC WAS CONTRIBUTING FACTOR**

SUPPLIER	IMPROVEMENTS
Eldec Washington	Completed a new building and facility expansion program to provide space for its power conversion division. All BLACK HAWK battery systems and converters are currently being manufactured in this facility.
Bendix Corp. Florida	Made substantial capital investment to create a new facility in Jacksonville, Florida. The long-term commitment of this action provides an opportunity for Bendix to make extended plans into the future, thus, supporting Sikorsky's needs more effectively while offering added economy from a more favorable labor market associated with this region.
Hughes Aircraft California	Opened a new facility in Mexico in 1981 to allow offloading of other than BLACK HAWK component work. This provided capacity in California for increased long-range BLACK HAWK production.
Speco Division Ohio	Instituted capital refurbishment program to upgrade all existing gear equipment, including the placement of one new Gleason Gear Grinder for operation in April 1983.
Spar Canada	Initiated a two-year capital program in which the following is being procured: Gear Shaper, Cylindrical Grinder, Horizontal Machine Center, Devlig Jig Mill, Gleason Tester & Quench Press, and Moog Gear Measuring Machine.
Air Industries Long Island, NY	Continued its growth with the addition of the multispindle three-axis profiling and multispindle three-axis tool changer, machine tools. In addition, installed a computer equipped with full-scale plotting, graphics, and complete three-axis and five-axis capability. The above investment and the ability to project machine loading and sales has enabled them to guarantee support of the BLACK HAWK Program.

Source: Sikorsky Aircraft Division of United Technologies Corporation.

Subcontractors experience the same cost-reducing factors as Sikorsky. These cost reductions result from a more stable production program, improved production planning and scheduling, and reduced contract administrative effort. It is likely that prices paid to second-tier suppliers for parts and materials are also reduced to some extent as a result of multiyear contracting.

APPENDIX B  
CASE STUDY -- F-16 MULTIMISSION FIGHTER

BACKGROUND

Program Description

The F-16 multimission fighter<sup>1</sup> is a single-engine, lightweight, high-performance aircraft powered by a 25,000-pound thrust class afterburning turbofan engine. This highly maneuverable fighter performs missions involving air-to-air combat and delivery of air-to-surface weapons. The F-16 replaces the F-4 in the active Air Force fighter inventory and provides a modern and low-cost addition to both the active and reserve tactical fighter forces.

Programs related to the F-16 include the F-100 and F-110 engines, the AMRAAM and AIM-9L missiles, and LANTIRN. The airframe prime contractor is the General Dynamics Corporation located in Fort Worth, Texas. The engine prime contractor is the Pratt & Whitney Aircraft Group, a division of the United Technologies Corporation, located in East Hartford, Connecticut.

Program History

The Lightweight Fighter Program was initiated in December 1971. General Dynamics won the prototype competition and was awarded the F-16 contract in January 1975. Belgium, Denmark, Norway, and The Netherlands signed a Memorandum of Understanding with the United States Government in January 1975 for the purchase of 348 F-16 aircraft. Defense Systems Acquisition Research Council (DSARC) II met in March 1975, DSARC IIIA in January 1977, and DSARC IIIB in October 1977. The first production aircraft was delivered in

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<sup>1</sup>Source of program information is the Selected Acquisition Report, December 31, 1983.

August 1978. The United States Air Force (USAF) achieved initial operational capability (IOC) in October 1980 when the 4th Tactical Fighter Squadron, 388th Tactical Fighter Wing, Hill Air Force Base, Utah, successfully passed its first operational readiness inspection.

Total planned aircraft procurement for both USAF and foreign customers was increased to 2,651 in 1983. On July 8, 1983, the 1000th F-16 fallout ceremony was held at General Dynamics' plant. By the end of 1983, 995 F-16's were deployed worldwide. On August 30, 1983, a multiyear fixed-price-incentive (FPI) contract for 480 F-16 airframes covering USAF requirements for fiscal year (FY) 1982-1986 was definitized. In 1983 Congress provided funds for 54 additional airframes; 24 in FY 1984 and 30 in FY 1985. In June 1984, General Dynamics submitted a proposal for a second multiyear contract (MYC) covering USAF requirements for 720 airframes from FY 1986-1989 with options for procurement of 36 additional airframes each year. The subject of this case study report is the multiyear FPI contract for 480 F-16 airframes awarded to General Dynamics and definitized on August 30, 1983.

#### General Approach

Multiyear contracting for the F-16 multimission fighter aircraft program was selected for detailed evaluation because it was among the first MYCs approved. Information on this program was obtained from Selected Acquisition Reports and Contractor Cost Performance Reports and from staffs in the Office of the Secretary of Defense and Air Force Headquarters. Interviews were conducted during visits with staffs from the following organizations:

- F-16 Program Manager's Office  
Wright Patterson Air Force Base, Ohio
- General Dynamics Aircraft Corporation  
Fort Worth, Texas.

## MULTIYEAR CONTRACT

### Description

The first MYC, MYC1, definitized on August 30, 1983, was for 4 years for 480 F-16 airframes at a negotiated fixed price of \$2,644.8 million. The contract also provides for associated alternate mission equipment, related support equipment, and 14 avionics intermediate shops. Table B-1 shows the quantities ordered by FY.

TABLE B-1. F-16 PROCUREMENT QUANTITY BY FISCAL YEAR

	FY82	FY83	FY84	FY85	TOTAL
Aircraft	120	120	120	120	480
Avionics Intermediate Shops	5	4	3	2	14

### Justification of MYC1

The original justification material for multiyear contracting included estimated savings of \$246.0 million based on acquisition of 480 airframes for \$3,184.0 million if four annual contracts were awarded and \$2,938.0 million if one MYC was awarded, a savings of 7.7 percent of the annual contract value. The estimates of costs and savings were based on the contractor's proposal. The Air Force's estimate of savings was less than the contractor's estimate of \$350.0 million because the Air Force used lower inflation rates from the Office of Management and Budget (OMB) to project costs for three follow-on annual contracts. The MYC was later definitized at a negotiated value of \$2,644.8 million. The risks associated with potential instabilities in Air Force requirements, availability of funds, estimated costs, and contractor capabilities were all judged to be low. Configuration stability was judged to be moderate because the F-16 was transitioning from an

A/B model to a C/D model. The management of the configuration change was formalized in a Multinational Staged Improvement Plan (MSIP) to assure a smooth transition.

Favorable impacts on the defense industrial base were foreseen to result from efficiencies stimulated by competition for larger subcontracts, stability of the work force, and enhanced surge capability resulting from program stability and investments in plant and equipment.

#### Estimates of Savings

In 1981, General Dynamics submitted its proposal to the Air Force for an FPI contract to build 480 F-16 aircraft over 4 years covering FY 1982 through FY 1986 requirements. General Dynamics' proposed costs were \$3,336.0 million if the 480 aircraft were procured under four separate annual contracts or \$2,986.0 million if a single MYC was used. Estimated savings attributed to multiyear contracting are \$350.0 million, or 10.5 percent of annual contract costs. The current F-16 program manager's estimate of savings is \$258.0 million, or 8.0 percent of annual contract costs.

The F-16 program manager used the lower official inflation rates from OMB to estimate contract costs for the three follow-on annual contracts, which resulted in the lower estimate of savings. The negotiated MYC costs were \$2,644.8 million. Savings were not reestimated after contract negotiations, but the Air Force and General Dynamics believe that negotiations would reduce annual and MYC costs in the same proportions and the percentage savings attributed to MYC would not change.

Estimated savings by source, based on totals supplied by General Dynamics, are summarized in Table B-2 in both constant 1982 dollars and current dollars. Reduced vendor prices for parts and material comprise 74.8 percent of savings in constant FY 1982 dollars. These savings are based on supplier firm fixed-price (FFP) proposals and result from the economics of

large quantity buys [economic order quantity (EOQ)] and competition or threat of competition. The remainder of savings in constant dollars results from in-house efficiencies and savings in support equipment costs. The program manager's estimate of inflation avoidance is \$61.0 million and the contractor's estimate is \$153.0 million, which reflects the lower inflation rates discussed earlier.

TABLE B-2. ESTIMATED SAVINGS ATTRIBUTED TO MYC BY SOURCE

SOURCE OF SAVINGS	SAVINGS <sup>a</sup> (MILLIONS)	PERCENT
Parts and Materials	\$147.4	74.8
Subsystems	(83.2)	
General Material	(64.2)	
General Dynamics In-House	37.2	18.9
Manufacturing	(32.1)	
Engineering	( 5.1)	
Support Equipment	<u>12.4</u>	<u>6.3</u>
Savings (FY82 Constant Dollars)	\$197.0	100.0
Inflation Avoidance/Total Savings		
Program Manager's Estimate	\$ 61.0/\$258.0	
Contractor's Estimate	\$153.0/\$350.0	

<sup>a</sup> A distribution of estimated savings by source is estimated based on data supplied by General Dynamics in current dollars.

Since parts and materials had to be ordered for FY 1982 production aircraft before MYC1 was authorized, the FY 1982 aircraft were procured as though they were under an annual contract and little savings were realized from MYC1. Savings were realized on the FY 1983 through FY 1985 buys and, if MYC2 is approved, savings will be realized on all 4 years of that contract.

#### Contract Status

As of June 1984, 130 F-16 aircraft have been delivered on MYC1, reflecting delivery of the FY 1982 quantity and the first few of the FY 1983



buy. About half of the effort on the FY 1983 contract has been expended. The program manager's estimate is slightly below target cost for FY 1982 but is 6 percent higher than target for FY 1983. Parts shortages and the complexity of integration and assembly of C/D model wiring harness boards were cited as causes for the latter problem. Since FY 1983 is regarded as the first true year of multiyear contracting on the F-16, the amount of actual experience data on MYC1 is severely limited at this time.

The original contract was for 480 airframes for \$2,644.8 million. The cost of changes to MYC1 as of August 3, 1983, totaled \$459.4 million, reflecting 592 contract actions including actions affecting configuration, support equipment, and avionics intermediate shops.

#### MYC2

In July 1984, General Dynamics submitted its proposal to the Air Force providing for 180 aircraft per year procured under an MYC (MYC2) with options on the purchase of 36 additional aircraft per year for any or all of the 4 years of the contract covering FY 1986 through FY 1989 requirements. Estimates contained in budget justification submitted in February 1984 identify an 8.4 percent savings attributed to MYC2 if 720 aircraft are procured; if options are exercised and 864 aircraft are procured, estimated savings decline to 4.6 percent. Optional quantities of parts and materials must be procured from vendors as though under separate annual contracts and apparently result in some disruption to a smooth production process if not provided for in advance. If discounted costs are compared, estimated savings are 5.0 percent on 720 aircraft and 2.0 percent if optional quantities are purchased. Excluding inflation avoidance, vendor procurement accounts for about 80 percent of estimated savings.

In MYC2, all risk factors are judged to be low including configuration stability since all aircraft are C/D models that were introduced in MYC1.

## EFFECT ON PRIME CONTRACTOR OPERATIONS

### Investment in Plant and Equipment

Investments in plant and equipment at General Dynamics are made with the active participation of the Air Force through the technology modernization program. This program is credited with stimulating capital investments whether the prime contract is annual or multiyear. However, the stability created by a MYC that fixed production rates and procurement quantities for 4 years provided a firm basis for planning the capital investment program at General Dynamics.

### Production Process Efficiency

General Dynamics reported that several actions that reduce production costs were made possible by the MYC. Certain detailed parts that are fabricated at General Dynamics could be produced in multiyear quantities. The number of manufacturing lots was reduced from four to three, thereby reducing set-up time and manhours. Buffer stocks were increased on selected items, reducing the chances of parts shortages. Improvements were also made in tooling and machine operations.

### Administrative Effort

The total administrative effort for proposing and negotiating a single MYC and multiyear subcontracts is less than for four annual contracts. Total administrative costs are, therefore, less under the MYC.

### Assessment

Savings in prime contractor operations are a minor part of total savings that have been attributed to multiyear contracting. In both MYC1 and MYC2, these sources account for less than 15 percent of estimated total savings. Reduced vendor procurement costs and inflation avoidance make up 85 percent or more of all savings attributable to MYCs.

## RELATIONSHIPS WITH SUBCONTRACTORS AND VENDORS

### Competition

Competition or the threat of competition is believed to have resulted in reasonable price quotations from subcontractors. Of 32 total subcontracts for major items, 13 quotations were judged by General Dynamics to be reasonable as proposed, 11 were initially unacceptable but became reasonable after threat of competition, and eight quotations were obtained through formal competitions. Of the eight subcontracts competed, two resulted in a change to a new subcontractor.

### Subcontracting Process

In mid-1980, General Dynamics, aware of the possibility of multiyear contracting, decided to recompete all major systems that were not price competitive. Price quotations were obtained with options on quantities and production rates. Supplier bids were based on a production rate of 10 shipsets per month with variations ranging from 6 to 35 shipsets. Individual orders could be placed for quantities ranging from 20 to 800. Options were established in January 1980 constant dollars and converted to then-year dollars at the time of authorization. Optional prices were also obtained for amounts from 1 to 222 units coproduced with the European group. These price options were to remain valid through 1988 with deliveries through 1990.

For raw materials, machined parts, and electrical and mechanical hardware (high-volume, low-cost items), FFP proposals were obtained from vendors for up-front deliveries versus deliveries spread over time. Cost savings for upfront deliveries were balanced against increased cost of carrying inventories, financing cost, and potential obsolescence. Individual items were authorized for up-front delivery of the multiyear quantity if cost, schedule, and obsolescence conditions were favorable.

Parts and material orders had to be placed for the FY 1982 buy before MYC1 was authorized. A single year's quantity was purchased based on supplier quoted price options, which resulted in no savings attributable to the MYC in FY 1982. However, these same options were exercised to order 360 shipsets of parts and materials for FY 1983 to FY 1985 aircraft. Quantity discounts implicit in the supplier quoted prices were, thereby, obtained.

The option prices in the supplier bids definitize the magnitude of quantity discounts that suppliers are willing to give. These price/quantity/rate options have been exercised and will continue to be exercised in MYC2. The price options are the strongest evidence currently available for validating estimated savings attributed to multiyear contracting on the F-16.

#### EFFECTS ON SUBCONTRACTOR OPERATIONS

##### Investment in Plant and Equipment

According to General Dynamics, the combination of competition and FFP multiyear subcontracts has stimulated capital expenditures at first-tier subcontractor plants and may also have stimulated investments at second- and third-tier subcontractor plants of suppliers of major items. Specific examples of subcontractor investments were not available, and visits to subcontractors were beyond the scope of the present effort.

##### Other Effects

The prices proposed by General Dynamics' suppliers were significantly less for the MYC than for the annual contracts. This reduction has been attributed to inflation avoidance because of earlier contract commitment, the larger, more economic lot sizes, and increased competition.

Major subcontractors experience the same cost-reducing factors as General Dynamics. These factors include a more stable production program,

improved production planning and scheduling, and reduced contract administrative effort. Second-tier suppliers most likely would also benefit in a similar fashion, provided the parts or materials ordered constituted a significant part of their production base.

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